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RESEARCH ARTICLE OPEN ACCESS

COLOUR BASED IDENTIFICATION AND SORTING OF INDUSTRIAL ITEMS USING LABVIEW

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ABSTRACT

This paper focuses on Colour based separation of Industry based products or raw materials using LabVIEW Software for creation of process accurate to Colour identification using Colour Spectrum tool (an add-on of LabVIEW 2023 QI software), various devices used in the project are real-time sensing and actuating devices. Colour Sensing and separation is a very useful application in Food processing, Plastic product based Industries, Marble Industry etc. In this model we use Arduino UNO, USB Webcam, Solenoid Pusher, 12V Electric motor and other Framework modules. This module works based on live action and response type of Industrial process where time is of the essence. LabVIEW software being an integral part of creation of the process and automation, has a number of tools to offer and be used to interface with external devices through wired connection.

I. INTRODUCTION

This paper is based on Colour Sensing and separation using LabVIEW as it is has a real time application it is a very useful in Food processing, Fiber and plastic product Industries, Marble Industry, Textile Industry etc. RGB Modeling is the base of this project for which weused Vision and Motion a special drive of LabVIEW 2023 QI used for Colour based operations

The RGB color model is an additive color model in which the red, green and blue primary colors of light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue. The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the color model already had a solid theory behind it, based in human perception of colors. It is a device-dependent
color model: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual red, green, and blue levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same color across devices without some kind of color management.

II. THEORETICAL REFERENCE

The advancement of technology has led to the development of automated systems for industrial processes, including the identification and separation of products based on color [1]. This literature explores the implementation of color-based identification and separation systems using LabVIEW, a graphical programming platform widely used for automation and control applications [2]. The integration of LabVIEW with image processing techniques enables efficient color recognition and sorting of industrial products, enhancing productivity and quality control in manufacturing processes [3] and [4]. Various methodologies and algorithms are discussed, highlighting the effectiveness of LabVIEW in achieving accurate and reliable color-based identification and separation [5].

In modern industries, the need for efficient and reliable methods of product identification and separation is crucial for ensuring quality control and productivity. Traditional manual methods are often time-consuming and prone to errors, highlighting the importance of automated systems. Color-based identification and separation systems have emerged as a viable solution, utilizing the unique spectral characteristics of colors to differentiate and sort products [6]. Different Control Strategies can be possible through LabVIEW [7] and [8].

III. MATERIALS AND METHODS

The Software architecture of this system consists of a Desktop/Laptop and LabVIEW Software, in this the Digital webcam is joined to the Desktop/ Laptop which has a LabVIEW 2023 QI (32-bit) Software installed. We used the Webcam for sensing and the actuating par was left to Solenoid pusher which is controlled through LabVIEW via Arduino R3 SMD board when certain condition of Program created in LabVIEW is satisfied. The creation of program required the installation of particular drives from NI and VI Package Manager which are supporting software's for LabVIEW created by National Instruments. The basic block diagram is shown in Figure 1.

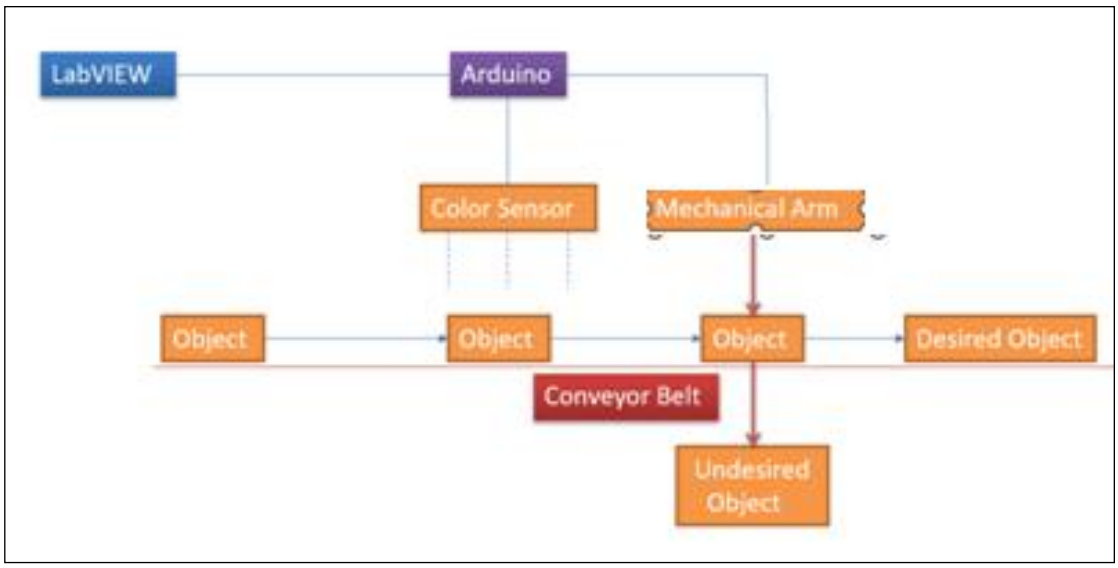

Figure 1: Basic Block Diagram.
Source: Authors, (2024).

ATmega328P controller has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [9]. The" SMD" stands for surface-mount device, and the microcontroller (ATmega328p) is soldered directly to the board.

III.1 RELAY MODULE

Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel 5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC).A 5v relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V.Pin1 (End 1): It is used to activate the relay; usually this pin one end is connected to 5Volts whereas another end is connected to the ground.

Pin2 (End 2): This pin is used to activate the Relay.

Pin3 (Common (COM)): This pin is connected to the main terminal of the Load to make it active.

Pin4 (Normally Closed (NC)): This second terminal of the load is connected to either NC/ NO pins. If this pin is connected to the load then it will be ON before the switch.

Pin5 (Normally Open (NO)): If the second terminal of the load is allied to the NO pin, then the load will be turned off before the switch.

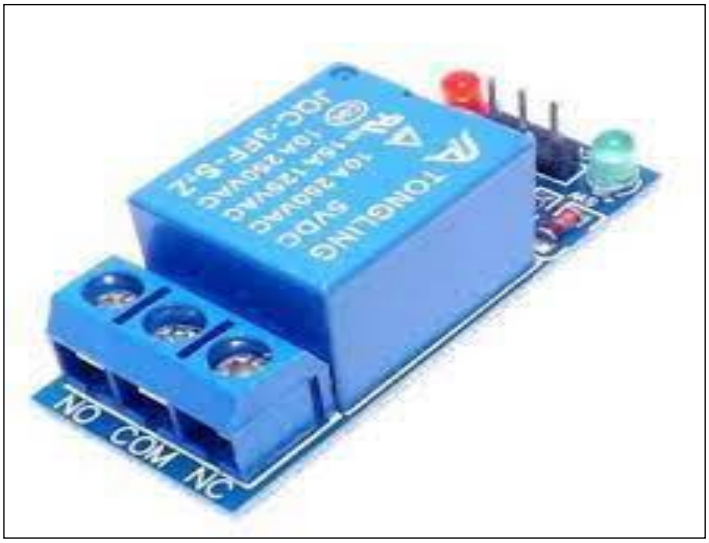

Figure 2: 5V Relay Module.
Source: Authors, (2024).

Full HD Video Calls with Stereo Audio: The Lenovo 300 FHD Webcam is powered by a Full HD 1080P 2.1 Megapixel CMOS camera that allows your friends, family, and colleagues to see you as clear as day, even when they are worlds

away. With full stereo dual-mics that are perfect for conferencing or long-distance video calls, they’ ll be able to hear you loud and clear, every time. High resolution FHD 1080P Webcam with dual mics: The innovative FHD 1080P camera delivers perfect high-resolution video and lets you set the scene with its ultra-wide 95° lens. Video alone is not enough, though, which is why two built-in mics capture crisp stereo audio from all directions. Easy Plug-and-Play Setup: Simply unpack and unfold the camera when you want to do a call, and plug the USB 2.0 cable into any Windows or Mac device. Within seconds, you will be ready to go live on your favorite conferencing or streaming software, with no drivers necessary.

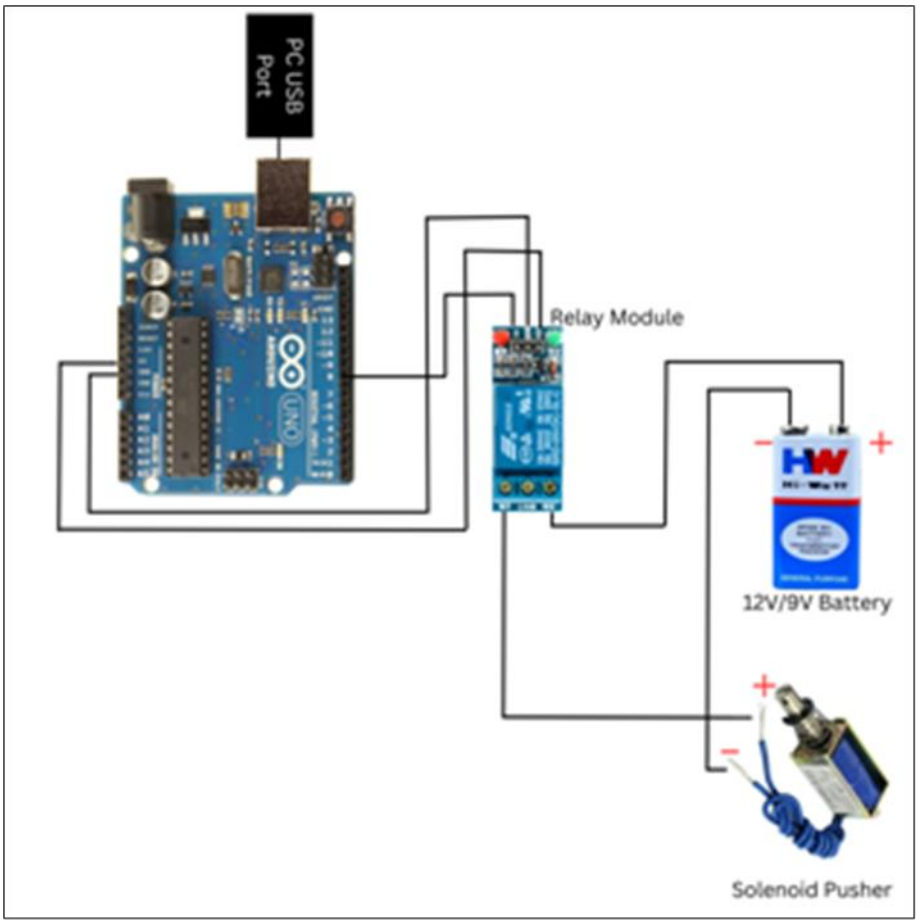

Figure 3: Circuit Connection.
Source: Authors, (2024).

III.2 ELECTROMAGNETIC SOLENOID

DC 12V rated voltage, 300mA rated current, 10mm stroke, 5GF force Pull push type, linear motion, plunger return, DC solenoid electromagnet DC Solenoid Electromagnet mainly used in vending machines, transport equipment, office facility household appliance, mechanical, etc Solenoids of this category work externally through pulling pushing in plunger When energized, doing work through pulling pushing in plunger joined object

DC Motor – 60RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size. Also, you don’ t have to spend a lot of money to control motors with an Arduino or compatible board. The most popular L298N H-bridge module with onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC or you can choose the most precise motor diver module from the wide range available in our Motor divers category as per your specific requirements.

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Jumper wires typically come in three versions: male-to-male, male-to female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into another end.

The Sensing part is the first process to take place as it is the heart of operation for which we use Digital webcam which is connected to Desktop/Laptop through its USB port as primary sensing device, webcam is interfacd with LabVIEW where RGB(Red-Green-Blue) colours are pre-defined and placed under certain case where the output at the end enables the actuator to do its work later [10].

The processing part is dependent on LabVIEW program and Arduino R3 Board which is connected with Laptop through usb port where after the sensing phase the coulour of the object is detected, in this case the Red colour object will be eliminated by

the Mechanical arm which is powered by Solenoid Electromagnet as the Red Boolean turns Green when the colour is detected as red, the boolean function further is connected with Boolean to Binary Function because the Arduino write function which enables the actuator through its Digital Pin 8 only takes Input as Binary(0,1).

The Actuating part is based on the devices connected to Arduino and are interfaced to LabVIEW by'. VI' program instead of Arduino code the only need of Arduino software is to recognize and select the type of Arduino connected with the laptop or desktop. The Electromagnetic Solenoid is commanded to actuate when Red colour is sensed and its boolean is turned on, after a delay the Solenoid hits the sensed red object as accurately timed with Conveyor belt speed.

IV. SOFTWARE

Before moving to the programming part, you need to install drivers to the LabVIEW 2023 QI and Arduino IDE Software must be installed in the same Computer to help the LabVIEW software identify Arduino Board [11]. The following are the list of Drivers that are used in the Program below.

Vision and Motion compiler enables you to use various Camera and image processing functions which interfaces your Pc with Cam modules such as IMAQ-dx which includes Snap, Configure Grab, Grab, etc.

• Vision and Motion Runtime Driver:

The V an M Runtime driver allows you to run LabVIEW Program and normal pc operations side by side as interfacing with 3rd party devices may cause nobilities in routine operation of operating system.

• Vision Acquisition Driver:

This package contains an interactive designs and Boolean programs which act as Indicators, Controllers as well as constants, for digital display through Camera this is necessary drive. All compiler and drivers are downloaded through NIPM.

• PC interfacing with Arduino:

This is the most popular cross platform connecting drive for connecting any hardware to the LabVIEW Software directly, designing systems and control them, and managing your deployed products at scale. Figure 4 shows the circuit connection in Arduino platform.

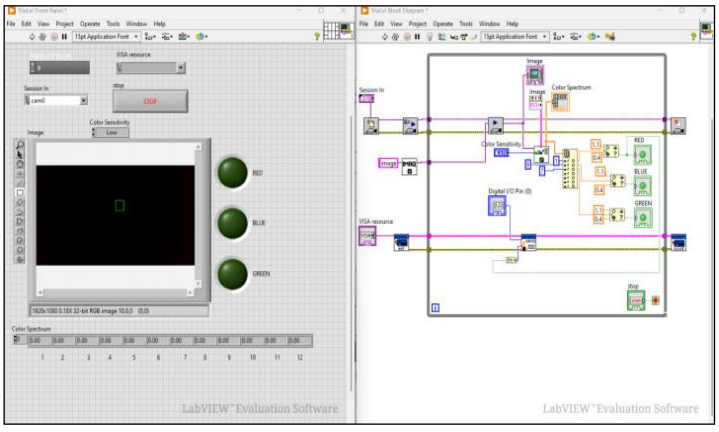

Figure 4: Circuit Connection.
Source: Authors, (2024).

IV. RESULTS AND DISCUSSIONS

Successful Detection of Colours categorized as Red, Green and Blue which is shown in figure 5.

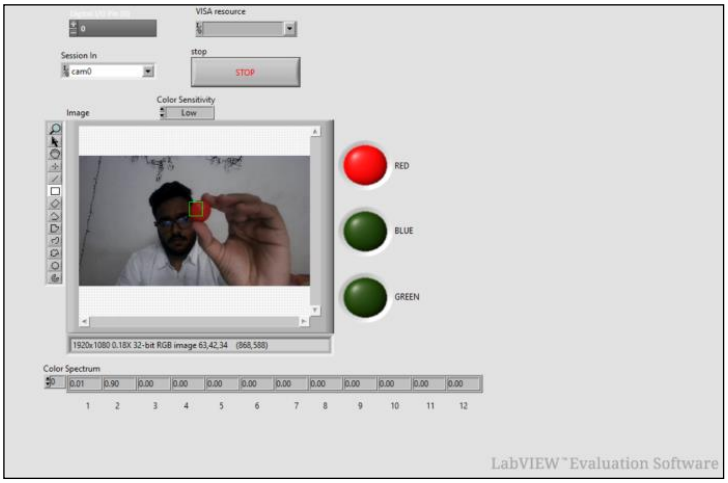

Figure 5: Detection of Red Colour.
Source: Authors, (2024).

• The conditions satisfying Detection were met without any errors to the program and hence are operational.

V. CONCLUSIONS

This System has wide range on Applications in Automation Industry for effective Colour Detection and Separation.

• Good scope in Food Processing industry as Fruits and Vegetables can be sorted automatically by their colour characteristics such as Green Apple from Red Apples, Grapes, Capsicum etc.

• The system is capable for variations and addition of excess parameters to be added so it is fit to be added to any real time processing industry.

• The system is a profitable solution for various small scale industries as well because of its flexibility and cost efficiency.

The objective was to produce a system that allows for colour sensing and separation of an object from other of different colour characteristic, Lab-VIEW and Webcam for colour detection will be used to detect the colour of the object in real-time as Red, Green and Blue in the detection node via the use of Colour Spectrum driver, it's only possible when the object passes through sensing box in same areas, distant detection can be made possible by calibrating the sensitivity of certain Function blocks and Scope of camera making the program significantly effective. With the use of IMAQ, Colour Write, Colour Spectrum organization tools, people can detect the colour pattern through operating station to take precise identification. The detection results in form on Boolean ON/OFF are transferred to" Write' function block via a" Bool to Num" to receive it in binary o,1 so that Arduino can recognize command ON/OFF. Thus, fulfilling the objective of creating the program to serve real time automation. There is a lot of scope improvisation and innovation on basis of colour with detection of fragmentation and mixing of colour. In order to increase the range of detection for conveying excessive parameters in the future, we mainly focus to use of a wide range of specialist ways. Also, we advise using LabVIEW for operation as addition of new drivers is constantly happening for creation and designing of various interactive functions and real-time processing rather than just the present. We truly want to move forward and continue to develop the framework in order to increase range of parameters that can be detected and operated like wisely. Also, we must include the possibility of remote control into main programming control interfacing.

VI. AUTHOR'S CONTRIBUTION

Conceptualization: Badri Narayan Mohapatra.
Methodology: Badri Narayan Mohapatra.
Investigation: Badri Narayan Mohapatra.
Discussion of results: Badri Narayan Mohapatra.
Writing – Original Draft: Badri Narayan Mohapatra.
Writing – Review and Editing: Badri Narayan Mohapatra.
Resources: Badri Narayan Mohapatra.
Supervision: Badri Narayan Mohapatra.
Approval of the final text: Badri Narayan Mohapatra.

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